IMPLEMENTATION OF THE SIMPLE MULTI-ATTRIBUTE RATING TECHNIQUE METHOD IN DSS SELECTION OF EXTRACURRICULAR ACTIVITIES

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Abstract—Extracurricular activities at SMAN 1 Cibungbulang are a means of exploring student competencies. Currently, students can choose extracurriculars without considering their interests and talents. It creates problems for extracurricular coaches because it is challenging to explore student competencies. In this study, the Simple Multi-Attribute Rating Technique (SMART) method was implemented and implemented in a decision support system to overcome this problem. This study used four alternatives: Basketball, Volly, Aikido, and Futsal. At the same time, the criteria are interests, talents, schedules, and achievements. The type of criteria used is benefit criteria. The decision support system is designed using object-oriented design and built on a web-based basis. The decision support system is access by every user registered on the system.

Keywords: Extracurricular, SMART Method, Decision Support System

Intisari— Kegiatan extrakurikuler di SMAN 1 Cibungbulang menjadi sarana dalam mengexplore kompetensi siswa. Saat ini siswa dapat memilih extrakurikuler tanpa mempertimbangkan minat dan bakatnya. Hal ini menimbulkan masalah bagi Pembina ektrakurikuler karena sulit mengeksplore kompetensi siswa. Untuk mengatasi masalah tersebut, maka dalam penelitian ini di implementasikan metode *Simple Multy Atribute Rating Technique* (SMART) dan di implementasikan dalam system pendukung keputusan. Pada penelitian ini menggunakan empat alternatif yaitu Basket, Volly, Aikido, dan Futsal. Sedangkan kriteria adalah minat, bakat, jadwal, dan prestasi. Jenis kriteria yang digunakan adalah benefit criteria. System penunjang keputusan dirancang menggunakan object oriented design, dan dibangun berbasis web. system penunjang keputusan dapat diakses oleh setiap user yang telah di daftrkan pada system.

Kata Kunci: Ekstrakurikuler, Metode SMART, Sistem Penunjang Keputusan.

INTRODUCTION

Developing students' potential according to students' talents, interests, creativity, and passion is one of the goals of national education. Developing students' potential requires systematic and continuous student development from the school. Student development through extracurricular and co-curricular activities.

"Student development materials consist of 1) faith and devotion to God Almighty. 2) Sublime ethics or noble morals. 3) Superior personality, national insight, and defending the country. 4) Academic, artistic, and sporting achievements according to talents and interests. 5) Democracy, human rights, and 6) Political education, environment, social sensitivity, and tolerance in a plural society. 7) Creativity, skills, and entrepreneurship. 8) Physical

quality, health, and nutrition based on diversified sources of nutrition. 9) Literature and culture. 10) Information and Communication Technology. Communication in English"[1].

SMA Negeri 1 Cibungbulang also did not escape student development activities. There are fourteen (14) extracurricular activities carried out, namely: 1) sports (badminton and volleyball), 2) sports (basketball and futsal), 3) sports (karate, silat, taekwondo), 4) women's scouts, 5) men's scouts, 6) rohis akhwat, 7) rohis Ikhwan, 8) PMR, 9) English Club, 10) KIR, 11) C. Move@Art, 12) Traditional Arts, 13) Band and 14) Paskibra[2].

Each student is free to choose the extracurricular they are interested in. Still, many students do not know what extracurricular suits their interests and talents, so many jump on the bandwagon. The extracurricular organization's performance makes it difficult for the coach to explore the potential of each student. Extracurricular activities are student activities outside of teaching and learning; extracurricular activities influence students' interests, talents, and achievements. Through extracurricular activities in the school environment, in the future, students can gain knowledge and experience that can be useful for them in everyday life. A decision support system is needed in recommending extracurricular activities that match the interests and talents of students.

Several literature reviews have been carried out that various methods can carry out extracurricular selection activities, one of which is using SMART (Simple Multi-Attribute Rating Technique which can be applied to decision support systems. Based on the results of research by Alif Catur et al., who tested the performance of the SMART method and SAW, the results showed that the SMART way could be used in providing choice recommendations even though the lowest value of a criterion reaches 0[3]. The SMART (Simple Multi-Attribute Rating Technique) method is a multi-attribute decision-making method. This multi-attribute decision-making technique supports decision-makers in choosing multiple alternatives[4]. Several studies have successfully applied the SMART method in solving the problem of selecting an option with many attributes through a decision support system for extracurricular selection carried out by students[5].

The application of SMART method is also applied in the SPK performance assessment, which includes 8 (eight) criteria, namely 1) social networking, 2) leadership, 3) communication, 4) integrity, 5) emotional control, 6) administrative management, 7) creativity and 8) independence[6]. The SMART method is also used in determining the provision of annual bonuses to employees, using 13 criteria, namely, work discipline, responsibility, initiative, creativity, ability to consider and make decisions, adaptability, attitude towards superiors, impressions of behavior, motor skills, physical condition, the amount of work produced and the quality of work results produced[7]. In addition, the SMART Method is also used in facilitating the determination of recipients of the Quran hafiz scholarship, based on four criteria, namely memorization of the Quran, high school academic scores (Senior High School), parents' work, and the number of dependents of parents[8]. In assisting fishermen with Smart Fishing tools to realize the Champion Fishermen and Champion Fish Warehouse programs in West Java, they also apply the SMART Method with the following criteria: 1. Photocopy of KTP, 2. Photocopy of KK Family Card, 3. Photocopy of DKK Ship Ownership Document, 4. Photo of FK Ship, 5. Statement of Ability to Operate, and 6. Maintaining SMART FISHING Tools[9]. SMART is also used in completing the selection of financial assistance in developing food businesses for the community, with legality criteria, the experience of trade activities, having AD / ART, grinding machines, and a storage warehouse area[10].

The SMART method is also used to select participants for basketball tournaments, making it easier for coaches to select participants[11]. The SMART method is also used to complete the coffee suppliers' selection at the Coffee Shop. The criteria are price, quality, delivery time, shipping cost, color, and post-harvest duration. Able to help Coffee Shop business people determine coffee suppliers[12]. The SMART method is also used to determine the beneficiary communities affected by covid by using the criteria of Integrated Community Welfare Data (DTKS) consisting of 10 standards, namely: home conditions, income, electricity voltage, education, employment, water sources, cooking fuel, age, and dependents. It makes it easier for village officials to decide on recipients of community social assistance[13]. The SMART method is also used to solve the problem of providing scholarships to lecturers for further study of doctoral education. The criteria used are NIDN, Period of Service, Teaching, Educational Qualifications, Research, Service, Functional Position, and Journal Publication[14]. The SMART method also solves the problem of selecting bamboo suppliers. The criteria used are Price, Quality, Delivery Time, and Service Provided[15]. They refer to several studies that the SMART method can solve problems in choosing alternatives with many criteria. Based on this, this study tries to apply the SMART method in solving extracurricular selection problems at SMAN I Cibungbulang.

MATERIALS AND METHODS

The research methodology uses the Waterfall method, as shown in figure 1. Calculation analysis using the SMART (Simple Multi-Attribute Rating Technique) method, shown in figure 2.
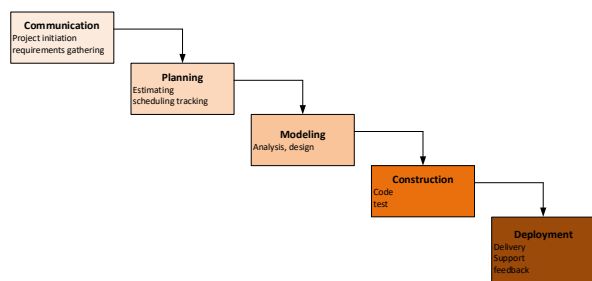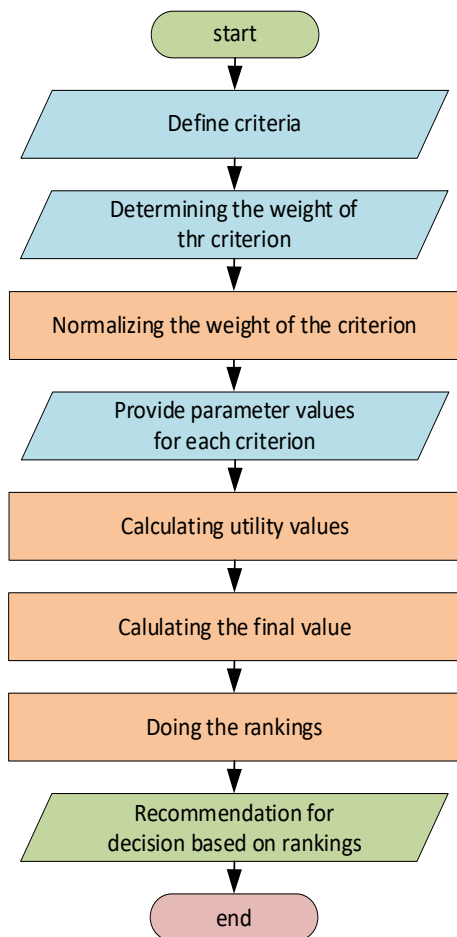

Figure 2. Waterfall method[16][roger presman]

Figure 2. Stages of analysis with the SMART method

Step communication through interviews, observation, and filling out questionnaires by students. This process is carried out to determine how the current business system is running, what is the extracurricular data, pengetria data, parameter value data for each criterion, and Student sample data is used in the analysis stage.

Step Planning to develop a work schedule for the system.

Step Modeling is carried out by analyzing problems with the SMART method and designing the needs of a decision support system.

Step construction to build a decision support system application. System development using the PHP programming language, a web server using Apache, a Google Chrome browser, and a MySQL database server. They are testing the system using a black box. The data sources for testing used are: 1) alternative data of Basketball, Volly, Aikido, and Futsal, 2) data on interest criteria, aptitude, training schedule, and student achievement.

The SMART (Simple Multi-Attribute Rating Technique) method uses the analysis data. The steps taken in the formulation of the SMART strategy are as follows:

1. Define criteria. The decision maker sets the data of the requirements. In the study, table 1 displays alternative data.

Table 1. List of Criteria

No	Code of Criteria	Name of Criteria
1	C1	Minat
2	C2	Bakat
3	C3	Jadwal
4	C4	Prestasi

2. Determine alternatives. Decision makers fix alternative data. Table 2 displays alternative data.

Table 2. List of Alternatives

No	Code of Alternative	Name of Alternative
1	A1	Basket
2	A2	Volly
3	A3	Aikido
4	A4	Futsal

3. Determine the weight of the criteria. They are determined on each criterion using an interval of 1-100 for each criterion with the most critical priority. The criteria used are the Benefit Criteria, shown in table 3.

Table 3. Bobot Criteria

No	Code of Criteria	Name of Criteria	Wight for Criteria
1	C1	Minat	40
2	C2	Bakat	15
3	C3	Jadwal	35
4	C4	Prestasi	10
	Total		**100**

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Normalize the criterion's weight by comparing the value of the criterion weight with the sum of the weights of the criterion in the following equation 1.

$$W_i = \frac{w_i'}{\sum_{j=1}^{m} w_j}$$ .... (1)

W_i: Normalized criterion weights for i-th criteria.

W_i' : Weight of the i-th criterion.
W_j: Weight of criteria
j: 1,2,3,…,m Number of criteria

Table 4. Normalization Results

No	Code of Criteria	Name of Criteria	Wight for Criteria	normalization
1	C1	Minat	40	40/100= 0,4
2	C2	Bakat	15	15/100=0,15
3	C3	Jadwal	35	35/100=0,35
4	C4	Prestasi	10	10/100 =0,1
Total				1

4. Provide parameter values for each criterion. The criteria values for each alternative are both quantitative and quantitative. This research uses qualitative and is converted to quantitative values. Grades are obtained through student representative interviews. The parameter values for each criterion are shown in Table 5.

Table 5. Parameter values for each criterion

	Minat	Bakat	Jadwal	Prestasi
Sangat	4	4	4	4
Cukup	3	3	3	3
Kurang	2	2	2	2
Tidak	1	1	1	1

5. Calculates the utility for each criterion. Assignment of utility values. Assignment of utility values. Data were obtained from questionnaires that students filled out. The data is shown in table 6.

Table 6. Test data

Code of Alternative	Criteria			
	Minat	Bakat	Jadwal	Prestasi
A1	4	3	1	1
A2	3	2	4	2
A3	2	1	4	2
A4	3	1	4	3
Minimum	**2**	**1**	**1**	**1**
Maximum	**4**	**3**	**4**	**3**

Because the criterion type is benefit criteria, equation 2 calculates utility values. The calculation results are shown in Table 7.

$$Uj_{(ai)} = \frac{(Cout - Cmin)}{(Cmax - Cmin)}$$ .... (2)

$Uj_{(ai)}$: j-th criterion utility value for i-th alternative

$Cout$: I-th alternative criterion value
$Cmax$: Maximum criterion value
$Cmin$: Minimum criterion value
Sample calculation

$$Uminat_{(A1)} = \frac{(4-2)}{(4-2)} = \frac{2}{2} = 1$$

Table 7. Utility calculation results

Code of Alternative	Nilai Utility			
	Minat	Bakat	Jadwal	Prestasi
A1	1	1	0	0
A2	0.5	0.5	1	0.5
A3	0	0	1	0.5
A4	0.5	0	1	1

6. They calculate the final value, Determining the absolute value of each by multiplying the value obtained from the normalization of the common data criterion value by the normalization value of the weight of the criteria. Then add up the multiplication value, which is used in equation 3. Moreover, the final calculation results are shown in Table 8.

$$U_{(ai)} = \sum_{j=1}^{m} wj * uj(ai)$$ .... (3)

$U_{(ai)}$: The total value for the i-th alternative.
wj: The value of the weight of the j-th criterion, which is already normalized.
uj: The value of the j-th criterion utility for the i-th alternative

Example calculation
Alternative final value A1 [Basket]
$= (w_{A1} * u_{A1(a1)}) + (w_{A2} * u_{A2(a1)}) + (w_{A3} * u_{A3(a1)}) + (w_{A4} * u_{A4(a1)})$
$= (1 * 0.4) + (1 * 0.15) + (0 * 0.35) + (0 * 0.1)$
$= (0.4) + (0.15) + (0) + (0)$
$= 0.55$

Table 8. The result of the calculation of the final value

Code of Alternative	Criteria				The final result
	Minat	Bakat	Jadwal	Prestasi	
A1	0.4	0.15	0	0	0.55
A2	0.2	0.075	0.35	0.05	0.68
A3	0	0	0.35	0.05	0.40
A4	0.2	0	0.35	0.1	0.65

Squealing. The final results are sorted from the largest to the smallest, then obtained in table 9.

Table 9. Ranking Results

Ranking	Alternative		Final grade
	code	name	
1	A2	Volly	0.68
2	A4	Futsal	0.65
3	A1	Basket	0.55
4	A3	Aikido	0.40

Based on the results of the ranking can be recommended to the student that Volly's extracurriculars are the best choice first, second, Futsal, third, Basketball, and fourth, Aikido.

RESULTS AND DISCUSSION

It is implementing the results of data analysis in a decision support system. So an analysis of system needs is carried out by studying business processes that run, shown in figure 4. Next, describe the business processes developed as shown in Figure 5, and also depict the use case diagram shown in figure 6.
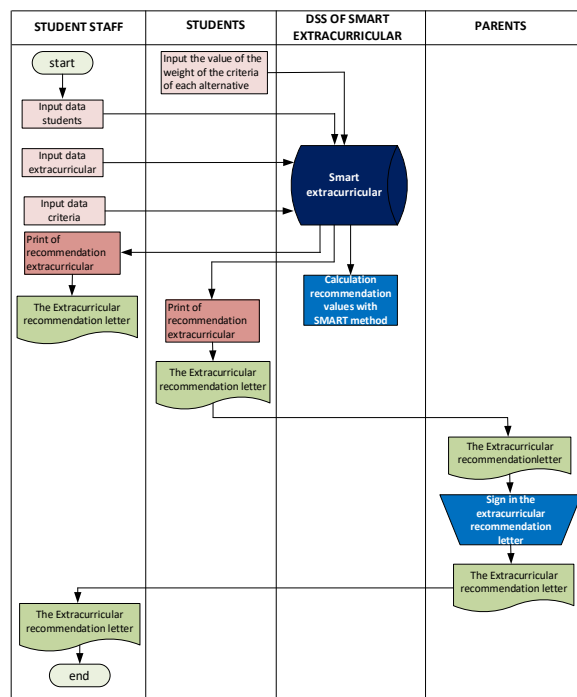

Figure 5. Developed business processes

In business processes that develop like figure 5, student staff will input student data, extracurricular data, and data criteria. Students will fill in the parameter values of each criterion, and then the system will process them with a SMART model. Furthermore, the system will display recommendations based on the ranking of values.
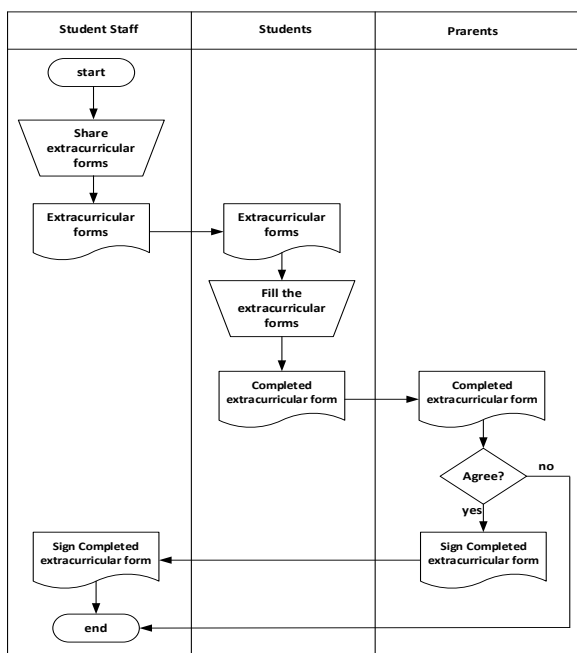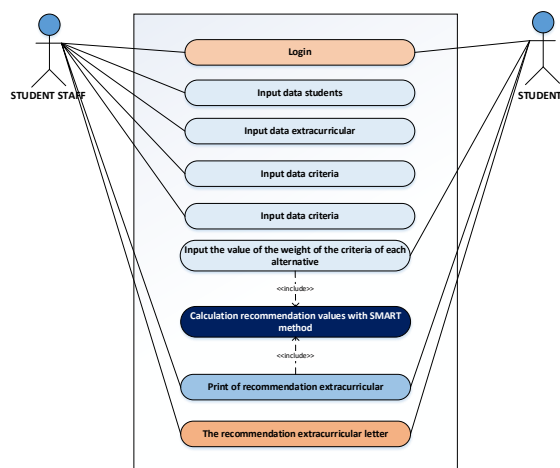

Figure 4. Existing business processes

Figure 6. Use case diagram

The use case diagram, it is shown how the relationship between the actor and the system. In the use case diagram, two actors are student staff and students whose authorization is each. There are nine use cases.
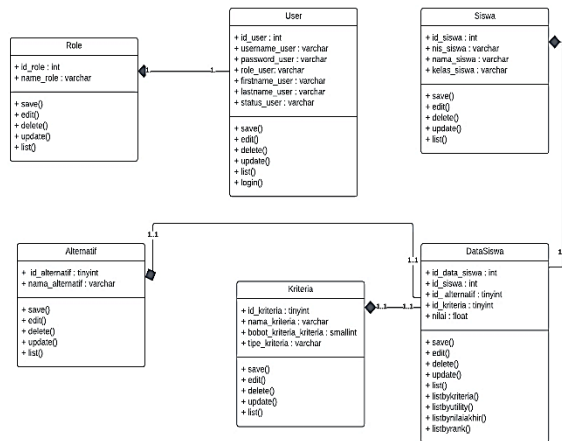

Figure 7. Class diagram

The diagram class illustrates the object's structure; six objects are in the extracurricular selection DSS.
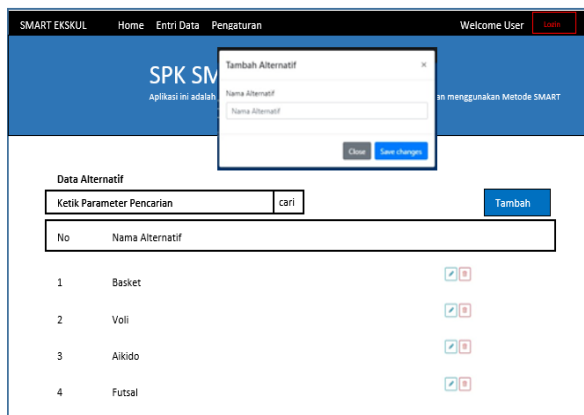

Figure 9. Input data alternative

After the system design stage is completed, the decision support system is built. Figure 9 shows how alternatives are inputted into the system. There are four alternatives Basket, Volly, Aikido, and Futsal
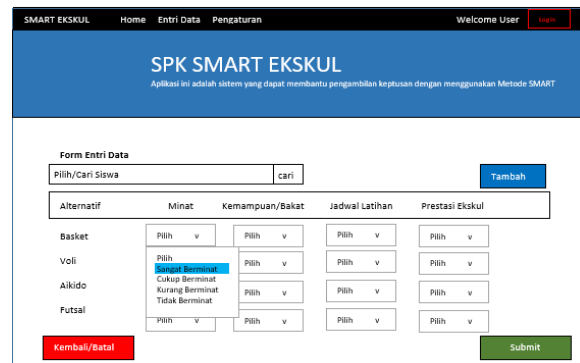

Figure 10. Input parameter values of each criterion

Students collect input data on each criterion's parameters to find extracurricular recommendations based on their interests and talents. The process of inputting parameter data is shown in figure 10.
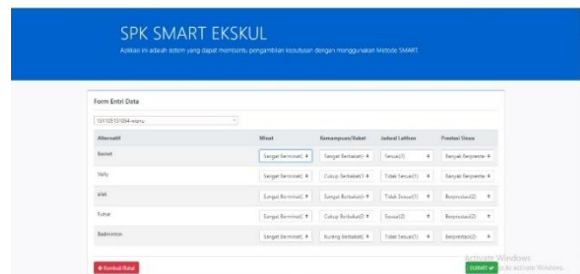

Figure 11. Calculating the final value with SMART

After the input data parameters of each criterion are carried out, the system will calculate the final value of each alternative using the SMART method. Inputting the value of each parameter is filled with qualitative, and the system will convert to quantitative value. This process is shown in figure 11.

CONCLUSION

The problem of choosing one alternative from many criteria that are often experienced daily in organizations to make decisions can be solved by the SMART method. The SMART method has two types of criteria: benefit and cost. Parameter values can be given qualitatively and quantitatively. Parameter values can be given qualitatively and quantitatively. This research uses the SMART method to solve the problem of extracurricular selection. Four alternatives are used: Basketball, Volly, Aikido, and Futsal. The criteria used are interests, talents, training schedules, and achievements. The resolution of this problem is also supported by the decision support system (DSS) application. The DSS application makes it easier for student guardians, staff, students, and parents to

manage data and obtain information. The study succeeded in applying the SMART method in DSS to solve the problem of extracurricular selection recommendations at SMAN Cibungbulang, Bogor regency.

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